State Water Resources Control Board
Division of Water Quality
GAMA Program

GROUNDWATER INFORMATION SHEET

Perfluorooctanoic acid (PFOA) & Related Compounds

The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The following information is pulled from a variety of data sources and mainly relates to drinking water. For additional information, the reader is encouraged to consult the references cited at the end of the information sheet.

GENERAL INFORMATION	
Constituent of Concern	Perfluorooctanoic acid (PFOA)
Aliases	C8, perfluorooctanoate, pentadecafluorooctanoic acid, perfluourcaprylic acid, FC-143, F-n-octanoic acid, PFO
Chemical Formula	$C_8HF_{15}O_2$
CAS No.	335-67-1
Storet No.	Not Available
Related Compounds	Perflourooctanesulfonic acid (PFOS), Perfluorononanoic acid (PFNA), Perflurooctanesulfonamide (PFOSA), and numerous other fluorinated telomers.
Summary	Perfluorooctanoic acid (PFOA) and related compounds have been identified as constituents of emerging concern (CECs). These compounds are very persistent in the environment, are found at low levels in the environment and in the blood of the general US population, will remain in people for a long time, and have been found to cause developmental and other adverse effects in laboratory animals. Under an agreement with the US Environmental Protection Agency (US EPA) and eight manufacturers, PFOA is slated for elimination from emissions and products by 2015. The State of California and Federal government do not have regulatory standards associated with PFOA in drinking water. California does not require monitoring or testing of drinking water supplies for this constituent.

REGULATORY AND WATER QUALITY LEVELS

The US EPA has established a Provisional Drinking Water Health Advisory for PFOA of 0.4 micrograms per liter (µg/L), or parts per billion (ppb). This advisory level is intended for short term (acute) exposures. The US EPA also established a health advisory for perfluorooctylsulfonates (PFOS), a related compound, of 0.2 µg/L.

Several states have passed groundwater quality regulations for PFOA. In West Virginia, residents must be provided with alternative drinking water when PFOA levels exceed 0.5 parts per billion (ppb, or 0.5 µg/L). Minnesota has adopted a standard of 0.3 µg/L. North Carolina has proposed, but not adopted, a regulatory standard of 1.6 µg/L.

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS

PFOA and related compounds are not currently analyzed in public drinking water systems. At this time there is no publicly available information regarding the distribution or detection of PFOA and related compounds in California public drinking water wells.

ANALYTICAL INFORMATION

Some analyses are capable of detecting PFOA at the nanograms per liter (ng/L), or parts per trillion (ppt) level.

HEALTH EFFECT INFORMATION

Based upon animal studies, the US EPA has recommended that PFOA be labeled a "probable human carcinogen." Industry and manufacturers have disputed the label. The animal studies also showed reduced birth size, physical developmental delays, endocrine disruption, and neonatal mortality.

In December of 2009, California's Office of Environmental Health Hazard Assessment (OEHHA) prioritized PFOA and related salts, transformation, and degradation products for possible listing under Proposition 65. Listing under Proposition 65 would require manufacturers to disclose the presence of PFOA as a potentially carcinogenic compound in materials in which PFOA and related compounds were present. A decision on whether to list the compound is pending.

In California, Senate Bill SB 1313 (2008) would have banned the use of PFOA in food packaging. The bill was passed by the California legislature, but was vetoed by Governor Schwarzenegger who favored a more comprehensive review of the issue.

OCCURRENCE	
Anthropogenic Sources	PFOA is a manufactured compound, and is used as a surfactant and emulsifier in a variety of products. It is used to make fluoropolymers, substances that impart valuable properties such as fire resistance, oil and water repellency, to provide non-stick surfaces on cookware, and to provide waterproof membranes for clothing. Products made from fluoropolymers include Teflon and GoreTex. Additional uses of fluoropolymers include carpet stain guards, fire-fighting foams, paints, cleaning products, paper coatings, and engineering coatings used in industrial manufacturing. Products made from fluororopolymers have been shown to contain trace quantities of PFOA. PFOA can also form as a degradation byproduct from other types of perfluorinated compounds (PFCs). PFOA is used as a surfactant and emulsifier in compounds used to coat a variety of food packages. Trace levels of PFOA have been observed in food that is packaged in these materials, including microwave popcorn bags. Perfluorooctyl sulfonates (PFOS), a related compound similar to PFOA, was widely detected in the blood of the general population in the 1990s. 3M, the manufacturer of PFOS, no longer produces this chemical.
Natural Sources	There are no natural sources of PFOA or related compounds.
History of Occurrence	Historically, both 3M and the DuPont corporations were the major producers of PFOA. The 3M corporation began manufacturing PFOA in the 1940s. DuPont began using PFOA in the 1950s. In 2000, 3M began phasing out production of PFOA and related compounds. Because of this phaseout, DuPont built its own PFOA manufacturing plant in 2002 in North Carolina. PFOA is still produced by DuPont and several other manufacturers. However, DuPont and 8 other manufacturers have, in an agreement with the US EPA, pledged to cease emission and eliminate PFOA in products by 2015. Under this agreement, PFOA would still be manufactured as a fluorotelomer precursor or building block, but would not be discharged to the environment and would not be included as a specific component in any product. Due to the chemical structure, PFOA is extremely stable and very long lived. It has been characterized as “virtually indestructible” in nature, and does not degrade from heat, light, or microbial action.

Contaminant Transport Characteristics	PFOA is a surfactant and as a result has both a hydrophilic and hydrophobic end. These characteristics allow PFOA to easily dissolve in water. PFOA has been detected in groundwater at several sites in the United States, most frequently in locations associated with manufacture and disposal of PFOA and related compounds.

REMEDIATION & TREATMENT TECHNOLOGIES

PFOA is long-lived, and does not degrade in groundwater. Every molecule of PFOA produced will persist indefinitely; incineration is required for complete PFOA destruction. However, reverse osmosis, nano-filtration, and activated charcoal are effective in removing PFOA from water. Anionic resins are being tested with a groundwater pump and treatment system at a landfill in Minnesota.

Recent evidence suggests that a number of degradation techniques may be effective in destroying fluorochemicals. These methods include photocatalytic oxidation, photochemical oxidation, photochemical reduction, thermally-induced reduction, and sonochemical pyrolysis. The effectiveness of these methods appear to depend upon the background water chemistry and degradation time.

ADDITIONAL RESOURCES
1. http://en.wikipedia.org/wiki/Perfluorooctanoic_acid 2. Defending Science, 2010. Case Study, Perflourooctanoic Acid. http://www.defendingscience.org/case_studies/perfluorooctanoic-acid.cfm 3. US EPA. 2010. Perflourooctanoic Acid and Fluorinated Telomers. http://www.epa.gov/oppt/pfoa/ 4. US EPA. 2010. Basic Information on PFOA and Fluoinated Teolmers. http://www.epa.gov/oppt/pfoa/pubs/pfoainfo.html 5. Minnesota Pollution Control Agency: Perfluorochemicals. http://www.pca.state.mn.us/index.php/waste/waste-and-cleanup/cleanup-programs-and-topics/topics/perfluorochemicals-pfc/perfluorochemicals-pfcs.html?menuid=&missing=0&redirect=1

FOR MORE INFORMATION, CONTACT:
John Borkovich, GAMA Program Manager (916) 341-5779